# The Health Effects of Air Pollution in Bangkok

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## Objectives

- The main objective of this study was to investigate the mortality risk from air pollution in Bangkok

## Background Information

Population 6.8 millions

Area 1600 km²

Hot and humid weather

## Daily Mortality Data from 1999 to 2003

- **Natural causes**
  - All ages, 0-4, 5-44, 45-64, 65+, 75+
- **Cardiovascular mortality**
  - Ischemic heart diseases
  - Stroke
- **Respiratory mortality**
  - COPD
  - LRI (all ages, <5)
  - asthma

## Summary of the Mortality data

| Mortality category | Deaths/day |
|---|---|
| natural causes | 95 |
| cardiovascular | 13 |
| Ischemic heart disease | 4 |
| stroke | 5 |
| respiratory | 8 |
| LRI (all ages) | 4 |
| LRI <5 | 1 |
| COPD | 2 |
| asthma | 1 |

## Air Pollution and Weather Data from 1999 to 2003

- **Air pollution data**
  - 24-hr $PM_{10}$
  - 24-hr $NO_2$
  - 24-hr $SO_2$
  - 8-hr ozone
- **Weather data**
  - Daily mean temperature relative humidity

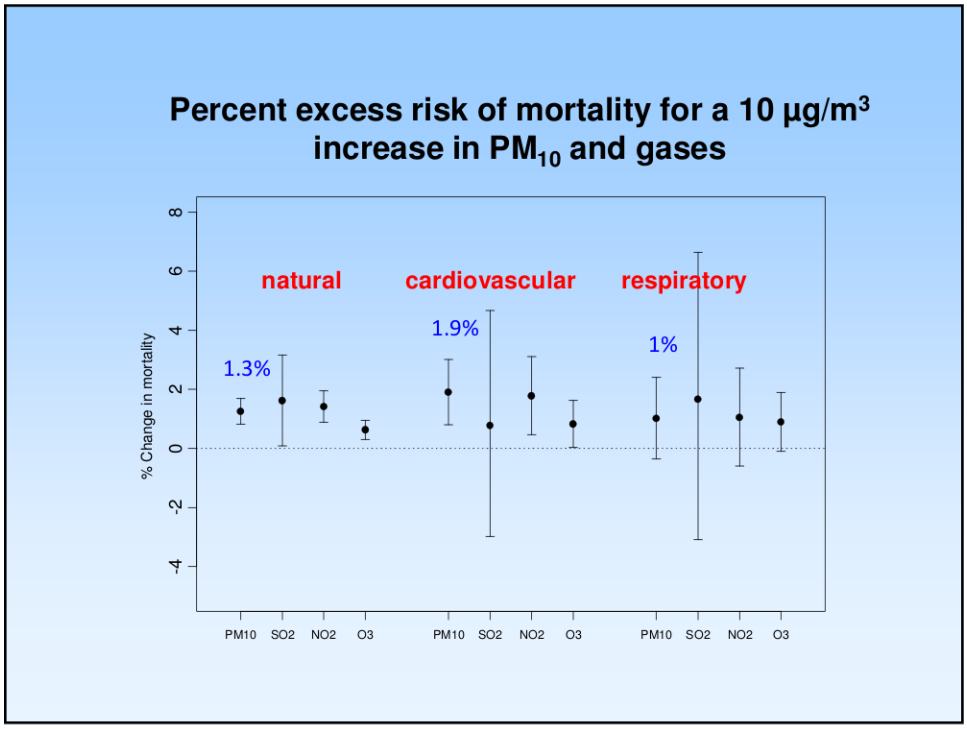
Air Monitors in Bangkok

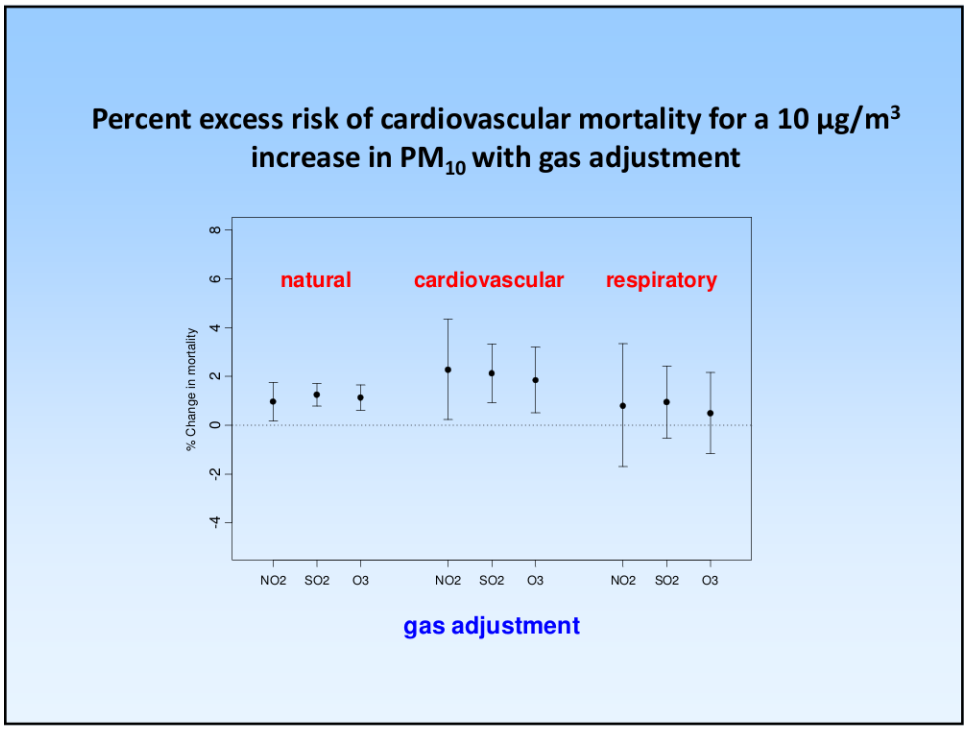
## Summary of the Air pollution and Weather Data

| Air pollutants and weather | Daily mean | SD |
|---|---|---|
| $PM_{10}$ (µg/m$^3$) | 52.1 | 20.1 |
| $SO_2$ (µg/m$^3$) | 5.0 | 1.8 |
| $NO_2$ (µg/m$^3$) | 23.8 | 9.2 |
| $O_3$ (µg/m$^3$) | 30.3 | 13.5 |
| Temperature (C˚) | 28.9 | 1.7 |
| Humidity (%) | 72.8 | 8.3 |

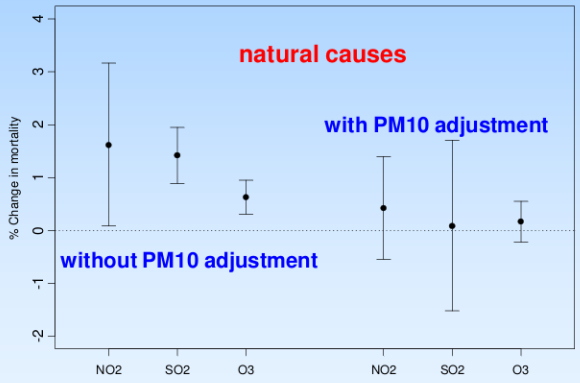
## Statistical Analysis

- Followed the PAPA common protocol
- Generalized Linear Model with Poisson regression
- Core model using natural cubic spline
  - time trend
  - temperature and relative humidity
  - days of week and holiday

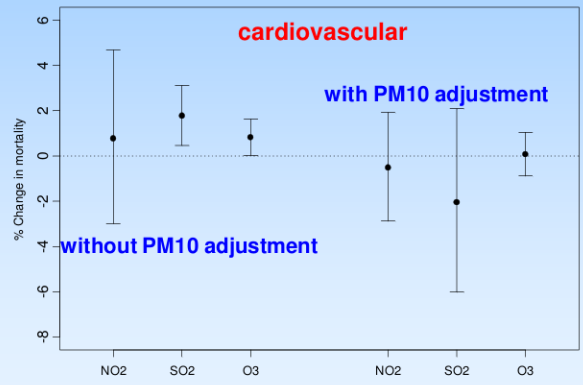

Percent excess risk of mortality for a 10 µg/m3 increase in PM10 and gases
natural
cardiovascular
respiratory
1.3%
1.9%
1%
% Change in mortality
PM10 SO2 NO2 O3 PM10 SO2 NO2 O3 PM10 SO2 NO2 O3


Percent excess risk of cardiovascular mortality for a 10 µg/m3 increase in PM10 with gas adjustment
natural
cardiovascular
respiratory
% Change in mortality
NO2 SO2 O3 NO2 SO2 O3 NO2 SO2 O3
gas adjustment

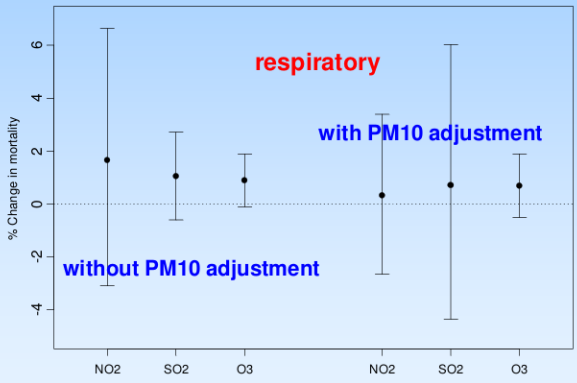
**Percent excess risk of non-accidental mortality for a 10 µ/m³ increase in gaseous pollutant levels**



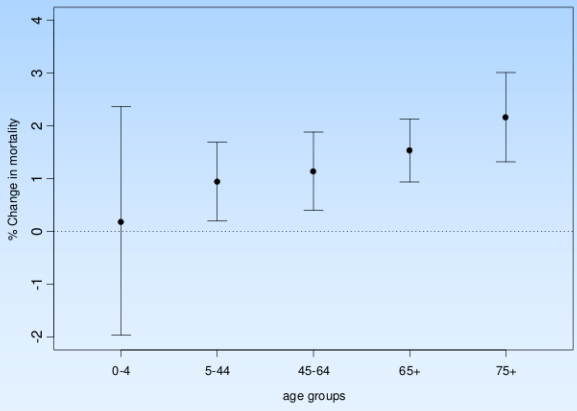

**Percent excess risk of cardiovascular mortality for a 10 µg/m³ increase in gaseous pollutant levels**



**Percent excess risk of respiratory mortality for a 10 µg/m$^3$ increase in gaseous pollutant levels**




**Percent excess risk of natural cause mortality for a 10 µg/m$^3$ increase in PM10 by age groups**



## Effects $PM_{10}$ on Cardiovascular Mortality

| Mortality Category | % excess risk (95% CI) |
|---|---|
| Cardiovascular | 1.9 (0.8, 3.0) |
| –Ischemic heart diseases | 1.5 (-0.4, 3.5) |
| –Stroke | 2.3 (0.6, 4.0) |

- Greater effect on stroke

## Effects of $PM_{10}$ on Respiratory Mortality

| Respiratory category | % excess risk (95% CI) |
|---|---|
| Respiratory | 1.0 (-0.4, 2.4) |
| –LRI (all ages) | 0.5 (-1.4, 2.5) |
| –LRI <5 yr | 7.7 (-3.6, 20.3) |
| –COPD | 1.3 (-1.8, 4.4) |
| –asthma | 7.4 (1.1, 14.1) |

- Elevated risk for asthma with wide CI

## Comparison of $PM_{10}$ Health Effects in Bangkok

| | % excess risk per 10 µg/m³ $PM_{10}$ (Natural Causes) | Daily mean $PM_{10}$ Level |
|---|---|---|
| Vichit-Vadakan et al, 1996 | 1.0 % | 65 µg/m³ |
| Vajanapoom et al, 2002 | 0.8% | 68 µg/m³ |
| Vichit-Vadakan et al, 2004 (PAPA) | 1.3% | 52 µg/m³ |

## Summary of Results

- Significant effects of $PM_{10}$ on several morality outcomes
- Elevated excess risks on the elderly and cardiovascular mortality especially for stroke
- Slightly higher effects of $PM_{10}$ than the previous studies in Bangkok,
- Greater effects of $PM_{10}$ than other PAPA cities

## Acknowledgement

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- The PAPA teams for contributions
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